

**THE EFFECTS OF BELOW-COST TELRIC-BASED UNE  
PRICES ON CLEC AND ILEC INVESTMENT<sup>†</sup>**

**Debra J. Aron, Ph.D.\***

**January 30, 2004**

---

<sup>†</sup> This paper was prepared for and funded by SBC.

\* LECG, LLC and Northwestern University.

## **THE EFFECTS OF BELOW-COST TELRIC-BASED UNE PRICES ON CLEC AND ILEC INVESTMENT**

by  
**Debra J. Aron**

---

### **1. Introduction**

The Telecommunications Act of 1996 (“Act”) requires incumbent local exchange carriers (“ILECs”) to provide access to elements of their networks to competitive local exchange carriers (“CLECs”) on an unbundled basis at prices based on cost. Although the determination of the prices of these unbundled network elements (“UNEs”) is left to the regulators in each state, the Federal Communications Commission (“FCC” or “Commission”) has the authority to prescribe the methodology for doing so. In its First Local Competition Order,<sup>1</sup> issued in August 1996, the Commission prescribed a methodology it called Total Element Long Run Incremental Cost (“TELRIC”) for the setting of UNE prices.

The prices for UNEs that are determined by state regulators using the TELRIC standard are typically less than the costs actually borne by the ILECs to provide these UNEs. By design, TELRIC measures the costs that would be incurred if the ILEC were instantaneously to rebuild its network in a manner that optimized the efficiency and minimized the cost of serving the customers in its territory given technology and demand conditions today. TELRIC-based prices are meant to reflect those that would prevail if each ILEC were able to fully capture the economies of scale and scope obtainable by serving the entire market, while operating in a local exchange market where prices conformed to those of a perfectly competitive market. In such a theoretical market, the prices for services would reflect those obtainable through the most efficient use of the lowest-cost technologies in an optimally designed network; any firm that sought to set the price of its services at a higher level would instantaneously lose all of its customers to an entrant who would offer services at a lower price over an instantaneously built, maximally efficient

---

<sup>1</sup> First Report and Order *In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*, CC docket No. 96-98 and *Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers*, CC docket No. 95-185, FCC 96-325 (August 8, 1996).

network. Such instantaneous competitive responses and ubiquitous availability of all resources necessary to build a maximally efficient network would ensure that prices never exceeded TELRIC-based prices.

While TELRIC-based UNE prices may reflect those that would prevail in a hypothetical idealized market, they do not reflect the prices that would prevail in any conceivably realizable competitive local exchange market. This is because TELRIC-based prices cannot reflect the fact that networks are built in real time and the fact that local exchange carriers must operate in a real world. For example, the carriers in a local exchange market with four, five, six, a dozen, or twenty competitors, no matter their relative sizes, would have to build, maintain, and upgrade networks in real time, and the prices of network elements and local exchange services in the market would reflect this fact. Rather than the prices of network elements and services reflecting an optimally efficient network built using today's lowest cost design and equipment, these prices would reflect the reality that the most efficient choices for network upgrades and improvements are constrained to a significant extent by existing network structures, design, and equipment. No competitor in the local exchange market would be able to offer network elements or services at prices based on the costs of a hypothetical network imagined in the determination of TELRIC-based prices. Instead, they would offer these services at (generally higher) prices that reflect the costs borne by an efficient carrier competing in a real-world market and meeting the competitive pressures to minimize costs.

Much as competitive markets create such incentives for efficiency, the price-cap regulatory regimes under which most ILECs have operated for several years have created powerful incentives to ILECs to minimize costs. As of 1998, price cap regimes were in place in thirty states, and today they are in place in forty-three states. These regimes allow Regional Bell Operating Companies ("RBOCs") to enjoy the benefits of optimizing the efficiency of their networks and of minimizing the costs of providing UNEs to CLECs and services to customers. ILECs have responded to the powerful incentives provided by price-cap regulation as well as by increasing intermodal competition from sources such as wireless, cable and VoIP. As a result, it is reasonable to assume that, absent specific evidence to the contrary, the costs ILECs currently bear to provide network elements to competitive carriers are a reasonable approximation

of the prices that would prevail in any conceivably realizable real-world competitive local exchange market.

The levels of costs that ILECs have been able to achieve reflect the efficiencies that can be achieved in the real world, and not those that can be achieved in the hypothetical world imagined by TELRIC as it is currently formulated and applied. Not surprisingly, the real-world costs of network elements typically exceed the respective TELRIC-based prices. In a recent study, Gerry Keith, Frank Pampush and I found that in 2001 TELRIC-based UNE prices set by state regulatory commissions were below the costs incurred by ILECs to provide those network elements in forty-four of the forty-eight states (and Washington D.C.) that we studied.<sup>2</sup> On average, UNE-P prices were about \$10.46 per line per month below the costs borne by ILECs to provide these network elements.

This disparity between TELRIC-based UNE prices and the costs borne by the ILECs providing these UNEs has significant consequences. ILECs face a disincentive to invest in their networks in the long run if they are forced to sell access to their network elements at prices below the cost of providing them, and CLECs will not rationally invest in their own facilities if they are able to reliably gain access to ILEC network elements at prices below the costs they would bear to build their own.

The claim that lower UNE prices would, all else equal, discourage investment, while intuitively compelling, has been disputed by CLEC economists. The Phoenix Center for Advanced Legal & Economic Public Policy Studies (the “Phoenix Center”) has argued that their econometric studies “confirm that UNE-P competition increases Bell Company investment in local telecommunications plant.”<sup>3</sup> In a white paper filed by AT&T before the FCC, Robert Willig, William Lehr, John Bigelow, and

<sup>2</sup> Debra J. Aron, E. Gerry Keith, and Francis X. Pampush, “State Commissions Systematically Have Set UNE Prices Below Their Actual Costs,” January 2004. (Hereafter, *Aron, Keith and Pampush*).

<sup>3</sup> “UNE-P Drives Bell Investment: A Synthesis Model,” *Phoenix Center Policy Bulletin No. 6*, Phoenix Center for Advanced Legal & Economic Public Policy Studies, September 17, 2003, p. 3. (Hereafter, *Bulletin No. 6*). See also “Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P,” *Phoenix Center Policy Bulletin No. 5*, Phoenix Center for Advanced Legal & Economic Public Policy Studies, updated September 17, 2003. (Hereafter, *Bulletin No. 5*).

Stephen Levinson (“Willig *et al.*”) argue that lower UNE prices induce competition, and that the competition induced by unbundling stimulates ILEC investment.<sup>4</sup> These authors also offer econometric analysis that they claim supports their hypothesis. I will discuss some defects in the AT&T analysis later in this paper. The key point, however, is that none of these papers addresses the question of whether non-compensatory UNE prices damage investment. They either fail to account for UNE prices at all (the Phoenix Center papers) or improperly *assume* that prices are compensatory (the Willig analysis). I am aware of no theory that would predict that a requirement to sell UNEs at prices that are not compensatory would stimulate investment.

The CLEC econometric analyses of which I am aware address only ILEC investment, not CLEC investment. To the extent that CLECs attribute any value to the goal of facilities-based competition, they argue that the availability of UNEs promotes that goal by giving them a “toehold” in the market from which they can make facilities investments that would otherwise be uneconomic, thereby stimulating CLEC investment. As a matter of straightforward economics, however, one would expect that if UNE prices are not compensatory, such uneconomic UNE prices would encourage CLECs to purchase these subsidized UNEs rather than to make risky investments in their own network. Indeed, the availability of below-cost UNEs damages the ability of (actual or potential) facilities-based CLECs to succeed in competition with UNE-P based CLECs, because the latter would have a cost advantage over the former. The distorting effect of below-cost prices may well persist indefinitely so that, contrary to the “toehold” argument, CLEC decisions would be distorted against investment even in the long run. Below-cost UNEs would be expected to squeeze out facilities-based competition and, thereby, depress CLEC investment.

In section 2 of this paper, I discuss evidence that CLECs rationally respond to the opportunity to gain access to UNE-P lines at below-cost prices by opting to employ UNE-P entry rather than making investment in facilities by engaging in facilities-based entry with UNE-L. Using data

---

<sup>4</sup> Robert D. Willig, William H. Lehr, John P. Bigelow, and Stephen B. Levinson, *Stimulating Investment and the Telecommunications Act of 1996*, October 11, 2002, white paper filed by AT&T before the Federal Communications Commission in CC docket Nos. 01-338, 96-98 and 98-147, October 11, 2002. (Hereafter, Willig *et al.*)

from SBC to which I was provided access, I provide a case study of the Ameritech region that shows that the *mix* of facilities and non-facilities-based competition appears to be significantly affected by whether UNE prices are or are not compensatory; though the overall amount of competitive penetration is not. That is, uneconomically low UNE-P prices lead to UNE-P competition crowding out UNE-L competition, but does not, in my study, lead to more competition over all. I also show that across the thirteen SBC states, the evidence is consistent with a hypothesis that UNE-P crowds out UNE-L, rather than promoting it.

In section 3, I discuss the analyses by the Phoenix Center filed on behalf of Z-Tel, and by Willig *et al.* on behalf of AT&T. I explain why the Phoenix Center studies are not relevant to the question of whether uneconomic UNE-P prices discourage investment; and I explain that the Willig econometric study suffers defects that, when corrected, destroy their key result.

---

## **2. The effects of below-cost UNE-P prices on CLEC investment**

In previous research, I have found that commissions in most states in the U.S. have established UNE prices that are significantly below the actual, booked costs incurred by the CLECs for providing the relevant UNEs.<sup>5</sup> My co-authors and I found, however, that the magnitude of the deficit varied significantly across states. An interesting case study of this fact, and its effect on competition, is the five former Ameritech states. Table 1 shows the UNE prices and ARMIS-based booked costs as of 2002 for these states.

---

<sup>5</sup> Aron, Keith and Pampush.

**TABLE 1**  
**ANALYSIS OF UNE-P REVENUES AND EXPENSES PER LINE PER MONTH FOR**  
**SOUTHWESTERN BELL TELEPHONE IN TEXAS AND THE SBC AMERITECH STATES**  
**(2001 ARMIS-BASED COST DATA)**

		Source	Illinois	Indiana	Ohio	Michigan	Wisconsin
1	Revenue (i.e., UNE Price)	<i>CCM November 2002</i>	\$12.22	\$12.15	\$13.42	\$14.50	\$21.73
2	Cost, including Capital Costs <sup>1,2</sup>	ARMIS/LECG	\$28.59	\$25.81	\$31.59	\$28.55	\$26.62
3	Net Margin (Loss)	L1-L2	(\$16.37)	(\$13.66)	(\$18.17)	(\$14.05)	(\$4.89)

**Sources:**

FCC ARMIS files (www.fcc.gov) (2001) adjusted by LECG analysts to obtain total wholesale (UNE) expenses and investment.

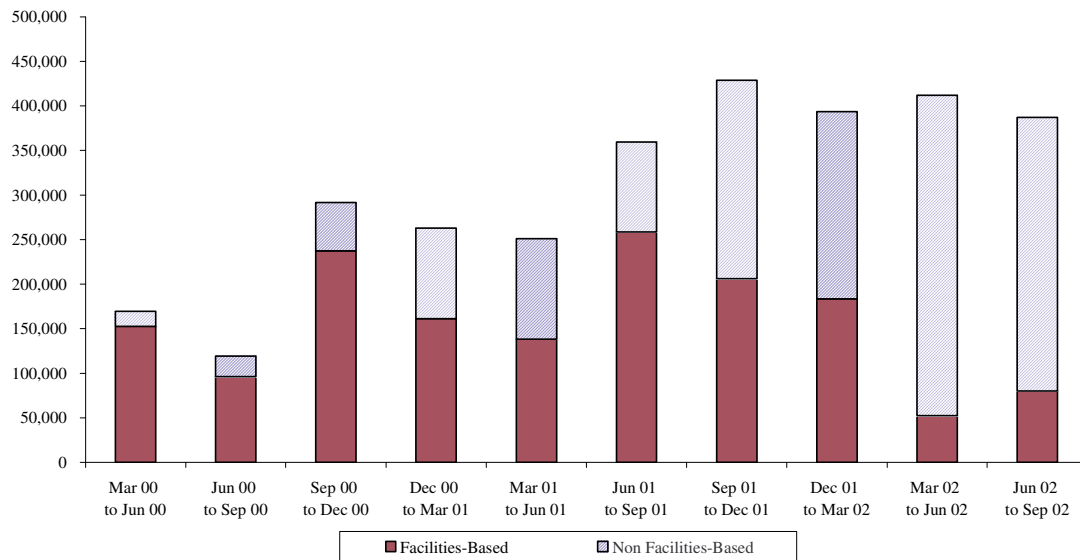
Anna-Maria Kovacs *et al.*, "The Status of 271 and UNE-Platform in the Regional Bells' Territories," Commerce Capital Markets Equity Research, November 8, 2002. (Hereafter *CCM November 2002*).

<sup>(1)</sup> Includes non-recurring charges amortized over 36 months. See Anna-Maria Kovacs *et al.*, "The Status of 271 and UNE-Platform in the Regional Bells' Territories," Commerce Capital Markets Equity Research, May 1, 2002, p. 11.

<sup>(2)</sup> Key assumptions: Loop costs are reduced by 17.8% in Illinois, 25% in Indiana, 18.15% in Michigan, 20.29% in Ohio, and 21.6% in Wisconsin, based on John Hodulik *et al.*, "How Much Pain from UNE-P?: Analysis of UNE-P Economics for the Bells," *UBS Warburg Global Equity Research*, August 20, 2002, p. 6, and on information provided by SBC. Additionally, assumed depreciation rates are FCC approved depreciation rates; and assumed cost of capital is 11.25%.

As the table shows, in 2002, UNE prices in four of those states—Illinois, Indiana, Michigan, and Ohio—were substantially below their booked costs. In one of those states, however—Wisconsin—UNE prices were, at that time, roughly comparable to the relevant booked costs in Wisconsin. These facts lend themselves to an interesting natural experiment, because these five states operate under the same parent company, using roughly the same network architecture and technology, and had similar regulatory policies. I find, however, that the competitive profile in the four low-price states was, at that time, substantially different from that in Wisconsin.

**Chart 1**  
**Quarterly Adds to CLEC-Served Lines (Net of Losses)**  
**by Provisioning Method**  
**Aggregate of Ameritech-Served States Less Wisconsin**



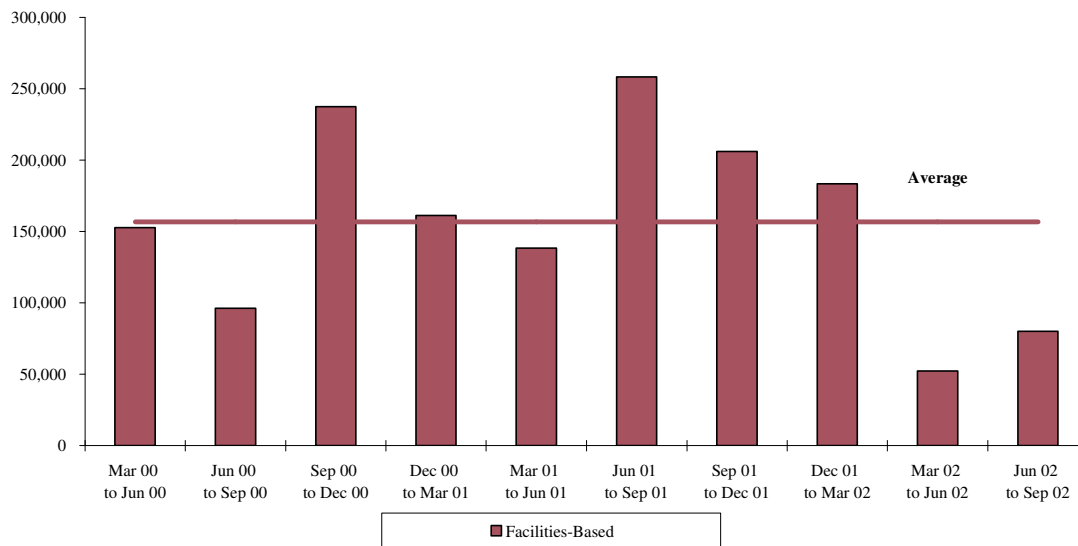
Source: LECG Analysis of Data Provided by SBC

## 2.1.CLEC entry in the Ameritech states

I examined the patterns of entry in the five Ameritech states from March 1, 2000 until September 30, 2002. This is an interesting time frame because during this time, UNE-P became widely available to CLECs in the Ameritech states; before this time, UNE loops were available, but UNE-P was not. I found that, over this time period, CLECs serving customers in SBC's territory in the Ameritech states engaged in relatively less facilities-based competition (i.e., self-provisioning and UNE-L) and relatively more non-facilities competition (UNE-P and resale). I examined the number of CLEC-served facilities-based lines and purely non-facilities-based lines at different time periods. Chart 1 illustrates the gains (net of losses) in CLEC-served lines by provisioning method for the aggregate of the four Ameritech states whose UNE prices clearly are well below the booked costs computed from ARMIS data: Illinois, Indiana, Michigan, and Ohio.

In aggregate, during the latest two quarters (through September 2002), CLECs added about 132,000 lines using their own facilities or the UNE-L but added 666,600 lines using resale or UNE-P. In other words, during the six months ending in September 2002, only about 17 percent of net new CLEC-served lines in the Ameritech states (excluding Wisconsin) were facilities based. The rest of the net new additions were either resale or UNE-P.

**Chart 2**  
**Quarterly Adds to CLEC-Served Facilities-Based Lines (Net of Losses)**  
**Aggregate of Ameritech-Served States Less Wisconsin**



Source: LECG Analysis of Data Provided by SBC

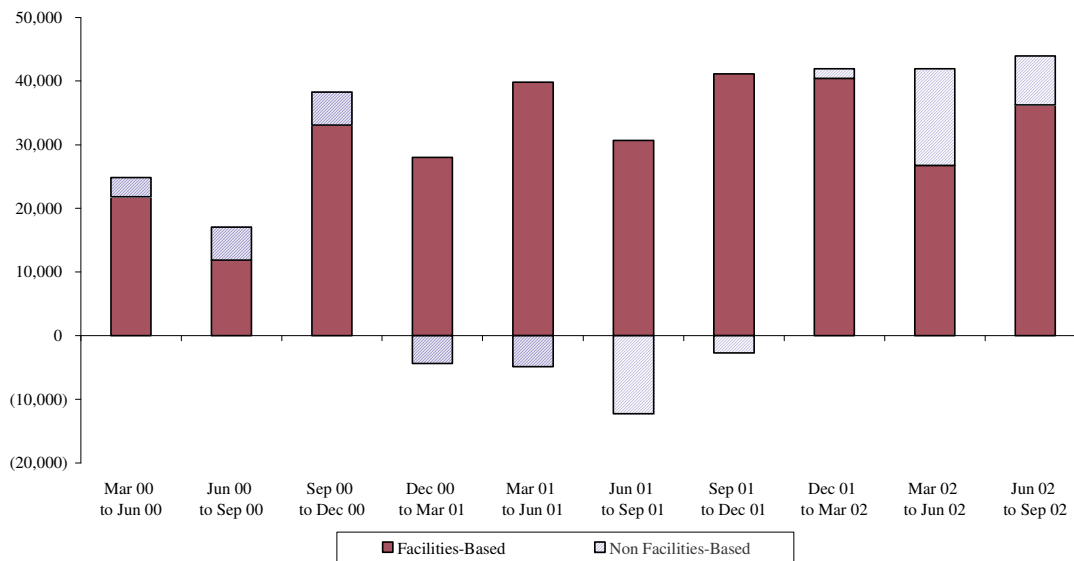
Chart 2 shows that CLEC-served facilities-based lines increased, but at a decreasing rate, so that the rate of additions (net of any losses) in the quarter ending September 2002 was only about half of what it averaged from March 2000 through September 2002.

The situation was far different in Wisconsin, the one Ameritech state whose UNE prices were close to booked costs during the period I studied. Chart 3 shows that Wisconsin added a substantial number of facilities-

based lines. During the two quarters ending September 2002, CLECs in Wisconsin added about 63,000 lines using their own facilities or UNE-L.

CLECs added about 22,860 lines using resale or UNE-P.<sup>6</sup> Thus, about 73 percent of the net new lines during the six months ending September 2002 in Wisconsin were facilities based (including the effect of the decrease in resale lines). Table 2 further illustrates some of the competitive issues in the five Ameritech states and shows that Wisconsin's strong showing of facilities-based lines was not based on a reduction of other competitive activity in the state.

**Chart 3**  
**Quarterly Adds to CLEC-Served Lines (Net of Losses)**  
**by Provisioning Method**  
**Ameritech Wisconsin**



Source: LECG Analysis of Data Provided by SBC

Table 2 shows net line additions by CLECs in Wisconsin and in the other four Ameritech states by method of provisioning (i.e., facilities-versus non-facilities-based). The "Total" column shows that in the four

<sup>6</sup> Wisconsin CLECs added about 55,000 lines using UNE-P, but there was a net reduction in resale lines of about 32,140 during this period.

quarters ending September 2002, CLECs won over nine percent of the Ameritech-served lines in the four states whose UNEs are far below the costs incurred and booked by the Companies. In Wisconsin, CLEC penetration was slightly lower than the average of the other four states (about 8.5 percent in the latest six months, annualized), but it was within the range of the other four states. However, the relative increases of facilities-based and non-facilities-based lines were very different. In the Ameritech states excluding Wisconsin, non-facilities-based lines were the source of the net increases, whereas in Wisconsin, facilities-based competition was the primary source of the increases in CLEC-served lines, by a substantial margin.

**TABLE 2**  
**ANALYSIS OF CLEC-SERVED NET LINE ADDITIONS**  
**IN WISCONSIN AND THE OTHER AMERITECH STATES**

TABLE 2 ANALYSIS OF CLEC-SERVED NET LINE ADDITIONS IN WISCONSIN AND THE OTHER AMERITECH STATES					
		Ameritech 2001 Retail Lines	CLEC-Served Net Line Additions		
			Facilities- Based	Non- Facilities- Based	Total
1	Ameritech States Excluding Wisconsin	17,127,415			
2	4 Quarters ending Sept. 2002				
3	Net New Lines		521,960	1,099,584	1,621,544
4	As a % of 2001 Ameritech Retail Lines		3.0%	6.4%	9.5%
5	2 Quarters ending Sept. 2002 (annualized)				
6	Net New Lines		264,840	1,333,202	1,598,042
7	As a % of 2001 Ameritech Retail Lines		1.5%	7.8%	9.3%
8	Wisconsin	2,021,433			
9	4 Quarters ending Sept. 2002				
10	Net New Lines		144,644	21,597	166,241
11	As a % of 2001 Ameritech Retail Lines		7.2%	1.1%	8.2%
12	2 Quarters ending Sept 2002 (annualized)				
13	Net New Lines		126,034	45,716	171,750
14	As a % of 2001 Ameritech Retail Lines		6.2%	2.3%	8.5%
NOTES:					
Source of Ameritech retail lines is 2001 FCC ARMIS report.					
Source of CLEC-served lines is SBC data and LECG computations.					

While I believe that the market was, and remains, in a considerable state of flux and uncertainty, and I therefore do not consider these trends and cross-sectional comparisons to be definitive, the evidence in the

Ameritech states is certainly consistent with the view that driving UNE prices below cost simply encourages synthetic competition relative to facilities investment. In fact, this apparent crowding out appears to be true in the SBC states in general.

To test whether crowding out appeared more generally than in the five Ameritech states I studied in detail, I performed a simple statistical analysis of CLEC use of UNE-P and UNE-Loops in the thirteen states in the SBC territory. The purpose of the analysis was to assess whether my observation from the five Ameritech states that UNE-P tended to be negatively associated with UNE-L held more widely. CLECs indeed have argued that their competitive stimulus hypothesis implies that states with more UNE-P also have more UNE-L,<sup>7</sup> so a simple assessment of whether this relationship in fact holds might be instructive to the validity of the CLECs' competitive stimulus hypothesis. If the CLECs' argument regarding UNE-P being a vehicle for entry that leads to investment in facilities for self-provisioning is correct, we should expect to see the most UNE-L lines in those states with the most UNE-P lines, and vice versa.

On the other hand, ILECs have argued that CLEC behavior is like that described in the previous section; CLECs choose UNE-P rather than facilities-based entry when states set below-cost UNE-P prices. That is, UNE-P and UNE-L are alternatives, and CLECs choose the form of entry that minimizes their costs. If this argument is correct, then there is likely to be a negative relationship between UNE-P and UNE-L, so that states with higher numbers of UNE-P lines will tend to have lower numbers of UNE-L lines and *vice versa*.

In order to test these competing hypotheses, I estimated a simple fixed effects regression model using data on the thirteen SBC-served states from December 1999 to December 2002. A fixed effects model is appropriate here because it controls for state-specific characteristics that are not explicitly modeled.<sup>8</sup> The dependent variable in this model is the number

---

<sup>7</sup> See, for example, Direct Testimony of Joseph Gillan on Behalf of AT&T Communications of Texas, L.P., Before the Public Utility Commission of Texas, Docket No. 25834, November 4, 2002.

<sup>8</sup> Peter Kennedy, *A Guide to Econometrics* (3<sup>rd</sup> ed.). (1993) (Cambridge: MIT Press), pp. 222-223.

of UNE-L lines. The right-hand-side variables are the number of ILEC end-user lines, the number of resale lines, and the number of UNE-P lines.

The results of my fixed effects regression analysis are provided in Table 4 below. The table shows that the observed relationship between UNE-L and UNE-P lines is negative. That is, all else being the same, the more UNE-P lines there are in a state, the fewer UNE-L lines, after controlling for state-specific factors that make some states more attractive, and for the size of the territory (controlled by the variable “ILEC end-user lines”).

<b>TABLE 4</b> <b>THE RELATIONSHIP</b> <b>BETWEEN UNE-L AND UNE-P</b>	
<b>Model Statistics</b>	
R-Squared	0.60
F statistic	35.29
<b>Parameter Statistics</b>	
Intercept	756,567
t-statistic	5.19
P-value	0.000
ILEC End User Lines	-0.14
t-statistic	-4.00
P-value	0.000
Resale Lines	-0.53
t-statistic	-2.60
P-value	0.011
<b>UNE-P Lines</b>	<b>-0.12</b>
t-statistic	-2.44
P-value	0.017

These results are inconsistent with the CLEC claim that UNE-P stimulates facilities-based entry. Rather, more consistent with the arguments presented by the ILECs, and consistent with the more detailed analysis of the Ameritech states that I presented above, UNE-P and UNE-L appear to be alternatives, suggesting that UNE-P crowds out UNE-L.

I now turn to a discussion of the effect of below-cost UNE-P prices on RBOC investment.

---

## **2. Econometric Analyses by CLEC Economists**

In its filing in the NPRM docket, Z-Tel Communications, Inc. has cited two econometric studies by the Phoenix Center for Advanced Legal & Economic Public Policy Studies as supportive of the claim that “unbundling at TELRIC rates and competitive entry have promoted competitive investment.”<sup>9</sup> These econometric models were designed to explain ILEC investment by changes in ILEC operating revenues, changes in the number of UNE-P lines, changes in the cost of capital, current and lagged values of average net investment and total plant in service, and current and lagged changes in a capitalized measure of operating revenue.

Others have pointed out many deficiencies of the Phoenix Center’s econometric studies and the implausibility of the results they obtain.<sup>10</sup> I merely note that the Phoenix Center econometric analyses, regardless of their merits or demerits, have no implications for the issues currently before the FCC in the TELRIC NPRM, because they do not in any of their econometric analyses include UNE prices as an explanatory variable for investment. The Phoenix Center studies examine ILEC investment as a function of a variety of factors, the key one being (changes in) the quantity of UNE-P lines in each state, but they entirely ignore the role of prices. Because the econometric models do not include measures of UNE prices, they cast no light on the issue in question – the effect of below-cost TELRIC-based UNE-P prices on ILEC investment. Hence, the

---

<sup>9</sup> Comments of Z-Tel Communications, Inc. *In the Matter of Review of the Commission’s Rules Regarding The Pricing of Unbundled Network Elements And the Resale of Service by Incumbent Local Exchange Carriers*, WC docket No. 03-173, (December 16, 2003), p. 10.

<sup>10</sup> See especially the critique of Phoenix Center *Bulletin No. 5* provided in the Declaration of Thomas W. Hazlett, Ph.D., Arthur M. Havenner, Ph.D., and Coleman Bazelon, Ph.D., on Behalf of Verizon Communications, Inc., Reply Comments of Verizon Telephone Companies in Support of Petition for Expedited Forbearance from the Current Pricing Rules for the Unbundled Network Element Platform, WC docket No. 03-157 (filed Sept. 2, 2003). The Phoenix Center ostensibly responded to these criticisms in *Bulletin No. 6*. However, their response was incomplete and failed to address several of the criticisms provided by Hazlett *et al.*

Commission would be well advised to dismiss the Phoenix Center's analysis for purposes of drawing inferences about the effects of the TELRIC methodology on investment, and I devote no further attention to these studies here.

In their white paper, AT&T economists Willig, Lehr, Bigelow and Levinson provide econometric analyses of two alternative hypotheses regarding the effect on investment of the availability of UNE-P lines to CLECs.<sup>11</sup>

The first they call the "investment deterrence hypothesis" and it is meant to represent the position of the ILECs. Under this hypothesis, unbundling discourages investment by making it less profitable. Willig *et al.* specify an econometric model that seeks to explain ILEC investment by factors affecting demand for local exchange services, ILEC current revenue, ILECs' cost of investment, and state regulatory regimes. Included in this set of explanatory variables is the UNE-P price, which is the key variable they use to test the investment deterrence hypothesis.

Their second competing theory is what they call the "competitive stimulus hypothesis." The hypothesis is that low UNE-P prices stimulate CLEC entry, and the competition created by CLEC entry induces ILECs to invest more.

As an initial matter, I note that, fundamentally, like the Phoenix group, Willig *et al.* have not articulated a theory that addresses the central question of the effect of below-cost TELRIC-based UNE-P prices on ILEC and CLEC investment. While (unlike the Phoenix group) Willig *et al.* address directly the effect of prices on ILEC investment, they do not consider the effect or even the possibility of UNE prices that are not compensatory. Rather, they *assert* that UNE prices are fully compensatory:

When priced using the Commission's TELRIC standard, UNE rates fully compensate ILECs for the economic costs of providing UNEs, including a risk-adjusted return on the ILECs

---

<sup>11</sup> Willig *et al.*

invested capital. ... So long as CLECs are paying rates that are at or above TELRIC, free-riding cannot occur.<sup>12</sup>

If one accepts their assertion, however, the key policy issue appears to me to be avoided. The fundamental problem with the TELRIC methodology is that, whether or not it compensates carriers for the costs they would incur in a hypothetical world in which they had unattainably low costs, it does not compensate carriers for costs that they have incurred in the real world,<sup>13</sup> or that they realistically could incur looking forward in the real world. Whatever the theoretical impact at the margin on investment of different UNE prices under the assumption that prices are compensatory, that impact would not reflect the effect on investment of non-compensatory prices. It strikes me as implausible, even if one accepts the Willig *et al.* competitive stimulus theory for compensatory UNE prices, that *below-cost* prices could stimulate investment in the long run. It is not unreasonable to believe that there may be merit to the stimulus hypothesis if UNE prices are expected to be genuinely compensatory in the real world (such as prices that would result from commercial negotiations would undoubtedly be). What is not credible is that, in the long run, a carrier would be stimulated to continue to invest in a network by additional competition when that competition is subsidized by the very network in which the carrier is investing. Hence, I believe that, like the Phoenix econometric results, the Willig *et al.* competitive stimulus hypothesis is not informative to the inquiry facing the Commission in the TELRIC NPRM. As my colleague William Rogerson and I discuss in our joint paper filed in this proceeding, the fundamental problem with TELRIC today is that it results in non-compensatory prices.<sup>14</sup>

Turning nevertheless to the Willig *et al.* econometric results, as I mentioned above, according to the investment deterrence hypothesis, levels of ILEC investment are predicted to decrease in response to decreases in the UNE price. However, the ILEC investment that Willig *et al.* seek to explain in their econometric specification is the ILEC's cumulative investment made over the several years since 1996

---

<sup>12</sup> Willig *et al.* pp. i-ii.

<sup>13</sup> See Aron, Keith and Pampush.

<sup>14</sup> Debra J. Aron and William Rogerson, *The Economics of UNE Pricing*, December 16, 2003.

(cumulative investment from 1996 and 2000 in one specification of their model, and cumulative investment made between 1996 and 2001 in the other), while the UNE price data used in the estimation are from June of 2002, well after the period of the investment purportedly being explained.<sup>15</sup>

The results of this econometric study indicate that ILEC investment had a negative statistical relationship with UNE-P prices, which Willig *et al.* interpret as contradicting the investment deterrence hypothesis (and, by extension, supporting the stimulus hypothesis). However, as other critics have noted before me,<sup>16</sup> the specification that is being tested here is entirely contrived: to accept that these results support or contradict the investment deterrence hypothesis, one must believe that investment during the period 1996 to 2001 could have been responsive to and driven by prices that were in effect in June 2002 (and, in many cases, were not in effect during much or all of the time that the investments were made). That is, ILECs are assumed to be able to look six years into the future, and are assumed to look throughout this particular six-year period to a single point in time in the future to form (with perfect foresight) their expectations and invest accordingly.

Economists recognize that investment decisions do depend on expectations. However, a far more plausible interpretation of the results is

---

<sup>15</sup> Willig *et al.*, p. 14.

<sup>16</sup> See Reply Declaration by National Economic Research Associates, Inc. On Behalf of BellSouth Corporation, *In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers*, CC Docket No. 01-338 (July 2002); *UNE Prices and Telecommunications Investment* by John Haring, Margaret L. Rettle, Jeffrey H. Rohlf, and Harry M. Shooshan III, Strategic Policy Research, submitted on behalf of Qwest, in its reply comments *in the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers*, CC Docket No. 01-338 (July 2002); and *An Appraisal of Professor Willig's Econometric Analysis*, Exhibits 2 and 3, by Timothy J. Tardiff submitted on behalf of SBC, as an appendix to Reply Affidavit of Alfred E. Kahn and Timothy J. Tardiff, *In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers*, CC Docket No. 01-338 (July 2002).

that the authors interpret the causality incorrectly. One hypothesis that is consistent with their results, and more plausible in light of the timing of the data, is that state commissions that had substantial service quality problems within their jurisdictions induced the ILECs to make significant investments during this time period to rectify the problems. Similarly aggressive regulatory outlooks may have led those same state commissions to order low UNE rates, whether in reaction to the service quality problems themselves or for other reasons. Alternatively, states in which carriers made significant investments by 2001 might have lower cost structures as a result, and those lower cost structures might have been partly reflected in lower UNE prices being ordered in 2002. In the first case, the low prices and the high investment both have a common cause, and in the second case high investment itself caused, or contributed to, low UNE prices. Given the timing of the investments and prices, either of these hypotheses is more plausible than the Willig interpretation.

Testing the sensitivity of Willig *et al.*'s results to the artificial timing structure of his specification is quite simple; rather than using data on the levels of investment over the 1996-to-2000 and 1996-to-2001 time periods, Willig *et al.* could have simply used readily available data on investment in the years 2000 and 2001. To test the sensitivity, I attempted to replicate Willig *et al.*'s analysis using contemporaneous prices and investments. In the first step of my analysis, I was able to roughly replicate Willig *et al.*'s results using his chronologically mismatched data, though I could not exactly replicate them due to the fact that he makes unexplained "adjustments" to his data, and my data sources were in some cases not identical to his. Nevertheless, I was able to find statistical significance of roughly the same magnitude and coefficients of the same sign and roughly same magnitude on the variables of interest as did Willig, using his functional form. However, when I replaced the investment variable with investment that was contemporaneous with the prices—that is, 2001 investment and 2001 UNE prices—the significance of the variables of interest disappeared.<sup>17</sup> See Exhibit 1.

---

<sup>17</sup> I used UNE-P price data from Commerce Capital Markets (CCM November 2002) rather than the NRRI data that Willig *et al.* used. The reason is that the NRRI data are not valid measures of UNE-P prices. NRRI's UNE-P prices include only loops and switching, excluding key components of the cost of UNE-P: transport and non-recurring costs, as well as some other costs. To the extent that his results are

Rather than finding that decreased UNE prices were related to higher levels of ILEC investment, as did Willig *et al.*, I found that lower UNE prices did not correlate with contemporaneously higher levels of investment. My change did not affect the number of observations and so the lack of significance was not due to simply decreasing the sample size. Rather, it appears that Willig *et al.*'s results are reliant on the very assumption that make them most implausible, and that most call into question his interpretation of the results. I believe that the results in Exhibit 1 show that the only reasonable interpretation of the Willig *et al.* results is that to the extent the correlation he finds is robust, it must reflect a reverse causality or third-factor causality that explains UNE prices, rather than explaining investment.

Indeed, a more sensible specification for testing whether lower UNE prices depress or stimulate investment would recognize that investment decisions are made well before the actual investments are observed. Hence, prices relevant to observed investments in a given year reflect, at least in part, prices effective a year or two earlier. My purpose here is simply to show that the Willig *et al.* results do not refute the investment deterrence hypothesis, because adopting a more reasonable time structure of the data eliminates their key results.

My results are most consistent with the view that current investment is not likely to be strongly driven by contemporaneous prices alone, but rather by a variety of expectations about the future prospects of the unbundling regime, the path of prices, the duration of the offerings, the overall economic conditions of the market, and other factors. It would not be surprising that the long-run depressing effects of below-cost UNE prices on investment would simply not be detectable in an econometric model today, when the determinants of investment are difficult to measure (and are not in the Willig model) and in which the market in fact is in a state of considerable disarray and uncertainty.

The Willig analysis that I have discussed was intended by its authors to directly test the investment deterrence hypothesis. They also devise a second analysis to test their "competitive stimulus hypothesis." In brief, they argue that low UNE-P prices instigate a two-step process that causes

---

sensitive to the use of the NRRI data instead of the more complete CCM prices, I believe this would further undermine his conclusions.

ILEC investment to increase. First, low UNE-P prices induce CLEC entry, and second, competition from these CLECs causes ILECs to “lower prices, to produce more, to improve the quality and range of services, to innovate, and to invest more in order to accomplish these goals.”<sup>18,19</sup> Willig *et al.* separately estimate regression equations for each of these two steps, and argue that if this two-step competitive stimulus hypothesis is correct, then they should find (if the regression equations are correctly specified) that a statistically significant negative relationship exists between UNE-P entry and UNE-P price (so that lower UNE-P prices are found to induce more CLEC UNE-P entry), and a statistically significant positive relationship exists between ILEC investment and CLEC UNE-P entry (so that more such entry induces more ILEC investment). Indeed, this is what they do find. They argue that this refutes the investment deterrence hypothesis.

To model this theory, Willig *et al.* specify two separate regression equations. The first is designed to explain CLEC entry by factors affecting the attractiveness of entry, including demand variables, ILEC revenues, the value of total service rebates, and UNE price, which is the key variable used to test the CLEC entry component of the competitive

---

<sup>18</sup> Willig *et al.* p. 6.

<sup>19</sup> Willig *et al.* also argue that if UNEs encourage a CLEC to enter that otherwise would not, the CLEC’s incremental (non-UNE) investments constitute a net increase in investment attributable to unbundling.

The focus of my discussion here is the disincentive effect that below-cost UNE-P prices have on ILEC investment. However, the argument presented by Willig *et al.* regarding CLEC investment highlights a basic flaw in their analysis that is worth noting; the existence of CLEC investment is not evidence that contradicts the investment disincentive hypothesis. Clearly, if a CLEC enters in response to below-cost access to an ILEC’s network, the CLEC will undertake some level of investment. However, when the price of UNE-P lines is set below the cost of supplying those lines, two wasteful outcomes can be expected.

First, such below-cost prices will promote market entry by CLECs whose business plans depend on the continued availability of those prices. When this occurs, entry represents a waste of resources because the true cost of the services provided by the CLEC will exceed its revenues. Furthermore, this inefficient CLEC may crowd out the entry of other efficient and viable CLECs, thereby reducing productive investment.

Second, CLECs will opt for UNE-P entry when it would be more socially efficient for them to enter with their own facilities, thereby reducing productive investment.

stimulus hypothesis. The second regression equation is designed to explain ILEC investment in terms of a measure of CLEC entry as well as factors affecting demand for local exchange services, ILEC current revenue, ILEC cost of investment, and state regulatory regimes. The second of these regression equations captures the substance of the competitive stimulus hypothesis—that ILEC investment increases with increases in CLEC entry. The first of the regression equations merely captures the idea that CLECs are more likely to enter when UNE-P prices are lower.

Willig *et al.* find, not surprisingly, that a statistically significant negative relationship exists between CLEC entry and UNE-P price. Their key result of interest is a statistically significant positive relationship between ILEC investment and CLEC UNE-P entry.

The results of this econometric exercise are deficient, however, for the same reasons that the estimation of the investment deterrence model was defective: investment in the 1996-to-2000 and 1996-to-2001 time periods is purportedly explained by the number of CLECs in the market *subsequent* to that time. This is entirely implausible for the reasons I discussed earlier. This approach is also unnecessary because it is a simple matter to estimate this regression equation with ILEC investment in 2000 and 2001 as the dependent variable.

Conducting the same sensitivity test on these regression results as I did on those for the investment deterrence hypothesis, I replicated the Willig *et al.* chronologically mismatched analysis of the two-equation regression model using comparable data. Once again, because my data differ, my replication is close but not exact. Nevertheless, I did obtain estimated coefficients of comparable magnitude and statistical significance that agreed in sign. I then estimated the two regressions using ILEC investment in 2001 as the dependent variable. Exhibits 2A and 2B contain the results of this analysis. Exhibit 2A shows estimated coefficients for the model where the log of the number of CLECs is the measure of CLEC activity, and Exhibit 2B shows estimated coefficients for the model where the share of Zip Codes with a CLEC is the measure of CLEC activity.

My results show, not surprisingly, that when the chronologically mismatched data on ILEC investment are replaced with 2001 data, no

statistically significant relationship exists between ILEC investment and CLEC entry.

When corrected, Willig's analysis provides neither support for the competitive stimulus hypothesis, nor a basis for questioning the validity of the straightforward argument that non-compensatory UNE-P prices undermine ILEC incentives to invest in local exchange networks.

#### **4. Conclusion**

The CLEC claims that the TELRIC methodology stimulates investment, whether ILEC or CLEC, are not supported by detailed analysis of case-study evidence of CLEC investment, nor by their own arguments and analyses. I believe that CLEC arguments regarding the effects of TELRIC on investment have been sufficiently vague that it may not have been entirely clear that, to a large extent, their empirical results are not directly relevant to the fundamental issues in the TELRIC NPRM proceeding. If one believes that TELRIC inevitably leads to compensatory prices, then the primary economic reason that TELRIC is harmful to investment is assumed away. If one accepts, however, that TELRIC in fact (as well as in theory) leads to non-compensatory prices, as I have shown elsewhere, the CLEC theory that TELRIC stimulates investment cannot hold. The CLECs' econometric results do not support the current TELRIC methodology because either they do not test the effect of prices at all, or the results are not robust to corrections in the timing of costs and investments. My analyses suggest that UNE-P in states with below-cost UNE prices crowds out facilities-based competition, while facilities-based competition dominates where UNE prices are in line with costs. UNE-L and UNE-P appear to act as substitutes, not complements. These results further support the economically intuitive result that below-cost prices are harmful to investment, and further indict the current TELRIC methodology as an unsound pricing methodology for unbundled network elements.

**EXHIBIT 1**  
**ILEC INVESTMENT EQUATION**  
**Reduced Form**  
**Ordinary Least Squares Estimation**

Description	Coefficient (Standard Error) Willig <i>et al.</i> 2002	Coefficient (Standard Error) LECG Estimates	Coefficient (Standard Error) LECG Estimates
<i>Dependent Variable is ILEC Investment:</i>	<b>1996 to 2001</b>	<b>1996 to 2001</b>	<b>2001</b>
<i>Source of UNE Price Data:</i>	AT&T, 6/02	CCM 2001 <sup>1</sup>	CCM 2001 <sup>1</sup>
<i>Source of Revenue Data:</i>	AT&T, Date unknown	NRRI 2001 <sup>2</sup>	NRRI 2001 <sup>2</sup>
Independent Variables			
Net Plant In Service per Capita 1996	0.0425 (0.0519)	0.1005 (0.0560)	0.4621 * (0.0210)
Labor Force Share in FIRE 00	899.0359 (460.0504)	314.0351 (576.6381)	-73.8938 (215.6576)
Population Growth	226.8131 ** (54.3407)	226.8376 ** (69.8801)	50.0506 (26.1345)
Average Unemployment	-10.3304 (6.3066)	-11.2157 (7.6540)	-6.7330 * (2.8625)
Average Revenue	6.6225 ** (2.0450)	0.0556 (1.9891)	0.0316 (0.7439)
<b>Telric</b>	<b>-4.1276 **</b> (1.3976)	<b>-3.4113 *</b> (1.6517)	<b>-0.8072</b> (0.6177)
Total Service Rebate	55.7267 (156.7003)	197.5452 (213.9827)	27.0505 (80.0277)
<b>UNE Price</b>	<b>-3.9071 **</b> (1.3141)	<b>-2.7868 *</b> (1.3266)	<b>-0.5646</b> (0.4961)
Price Cap	-3.1070 (20.1123)	-7.8476 (26.1362)	-12.5028 (9.7747)
Price Cap w/ Interim Freeze	1.3444 (20.7422)	1.9346 (24.3388)	-10.7584 (9.1025)
Freeze w/ non-index Cap	5.8072 (23.6068)	20.5704 (24.8841)	-5.3267 (9.3064)
Deregulation	-193.5255 ** (44.7283)	-157.3093 ** (48.7966)	-50.7302 ** (18.2495)
Constant	-75.1956 (79.7321)	92.9112 (97.8102)	59.6231 (36.5802)
Summary Statistics			
Number of Observations	47	47	47
F Statistic	9.65 **	6.52 **	2.94 **
R <sup>2</sup>	0.7730	0.6971	0.5096
Adjusted R <sup>2</sup>	0.6929	0.5902	0.3366

\*\* Statistically Significant at 99% confidence.

\* Statistically Significant at 95% confidence.

1. Source: Anna-Maria Kovacs et al., "The Status of 271 and UNE-Platform in the Regional Bells' Territories,"  
*Commerce Capital Market Equity Research*, May 1, 2002.

2. Source: *A Survey of Unbundled Network Element Prices in US* by Billy Jack Gregg, Updated July 2001, Table 3.

**EXHIBIT 2A**  
**ILEC INVESTMENT EQUATION**  
**Structural Form**  
**Ordinary Least Squares Estimation**

Description	Coefficient (Standard Error) Willig <i>et al.</i> 2002	Coefficient (Standard Error) LECG Estimates	Coefficient (Standard Error) LECG Estimates
<i>Dependent Variable is ILEC Investment:</i>	<b>1996 to 2001</b>	<b>1996 to 2001</b>	<b>2001</b>
<i>Source of Revenue Data:</i>	AT&T, Date unknown	NRRI 2001 <sup>1</sup>	NRRI 2001 <sup>1</sup>
Independent Variables			
Net Plant In Service per Capita 1996	0.0713 (0.0553)	0.1002 (0.0554)	0.0461 * (0.0207)
Log Number of CLECs	20.5623 * (9.4595)	106.1689 ** (38.8249)	19.5342 (14.4956)
Labor Force Share in FIRE 00	537.1570 (603.4192)	2959.0500 ** (1084.5850)	408.9225 (404.9397)
Population Growth	200.1888 ** (57.6205)	38.8595 (82.3259)	16.6735 (30.7371)
Average Unemployment	-9.3215 (6.6325)	-1.8978 (7.6643)	-4.8866 (2.8616)
Average Revenue	4.3023 * (1.9139)	5.0769 (2.7025)	0.9351 (1.0090)
<b>Telric</b>	<b>-4.2664 *</b> (1.6600)	<b>-3.7020 *</b> (1.5365)	<b>-0.8890</b> (0.5737)
Price Cap	1.7870 (20.6609)	-1.4102 22.7294	-10.6916 (8.4862)
Price Cap w/ Interim Freeze	7.9534 (21.2228)	6.6066 (22.7436)	-9.5958 (8.4916)
Freeze w/ non-index Cap	4.0174 (24.6087)	19.4323 (24.5252)	-5.6469 (9.1567)
Deregulation	-163.3171 ** (44.1765)	-153.7591 * (47.8010)	-49.7313 ** (17.8470)
Constant	-96.6967 (84.9063)	-431.6636 * 200.2604	-39.5702 (74.7691)
Summary Statistics			
Number of Observations	46	47	47
F Statistic	8.98 **	7.24 **	3.28 **
R <sup>2</sup>	0.7438	0.6947	0.5075
Adjusted R <sup>2</sup>	0.6610	0.5988	0.3527

\*\* Statistically Significant at 99% confidence.

\* Statistically Significant at 95% confidence.

1. Source: *A Survey of Unbundled Network Element Prices in US* by Billy Jack Gregg, Updated July 2001, Table 3.

**EXHIBIT 2B**  
**ILEC INVESTMENT EQUATION**  
**Structural Form**  
**Ordinary Least Squares Estimation**

Description	Coefficient (Standard Error) Willig <i>et al.</i> 2002	Coefficient (Standard Error) LECG Estimates	Coefficient (Standard Error) LECG Estimates
<i>Dependent Variable is ILEC Investment:</i>	<b>1996 to 2001</b>	<b>1996 to 2001</b>	<b>2001</b>
<i>Source of Revenue Data:</i>	AT&T, Date unknown	NRRI 2001 <sup>1</sup>	NRRI 2001 <sup>1</sup>
<i>Independent Variables</i>			
Net Plant In Service per Capita 1996	0.0208 (0.0581)	0.0999 (0.0556)	0.0461 * (0.0207)
Share of Zips w/ CLEC	38.9008 (20.0364)	108.6156 * (40.3370)	0.1986 (0.1503)
Labor Force Share in FIRE 00	857.7838 * (487.4477)	234.5476 (569.1980)	-92.0124 (212.1406)
Population Growth	202.7094 ** (56.4395)	122.3082 (66.7034)	32.0941 (24.8604)
Average Unemployment	-8.8375 (6.5968)	-13.0853 (7.2389)	-6.9407 * (2.6979)
Average Revenue	4.3609 * (1.9016)	-1.6744 (2.0192)	-0.3050 (0.7525)
<b>Telric</b>	<b>-5.0796 **</b> (1.3942)	<b>-3.8029 *</b> (1.5341)	<b>-0.9083</b> (0.5718)
Price Cap	8.2745 (20.0085)	0.8324 (22.5651)	-10.2595 (8.4100)
Price Cap w/ Interim Freeze	14.2341 (20.4350)	7.6639 (22.6276)	-9.2777 (8.4333)
Freeze w/ non-index Cap	-8.3251 (24.8101)	19.1914 (24.6057)	-5.6831 (9.1706)
Deregulation	-165.7673 ** (44.3738)	-152.4775 ** (47.8894)	-49.4814 * (17.8484)
Constant	-74.4393 (77.5440)	71.0456 (81.0707)	52.8962 (30.2151)
Summary Statistics			
Number of Observations	47	47	47
F Statistic	9.09 **	7.18 **	3.27 *
R <sup>2</sup>	0.7406	0.6931	0.5065
Adjusted R <sup>2</sup>	0.6591	0.5966	0.3514

\*\* Statistically Significant at 99% confidence.

\* Statistically Significant at 95% confidence.

1. Source: *A Survey of Unbundled Network Element Prices in US* by Billy Jack Gregg, Updated July 2001, Table 3.